

WATERFOWL BREEDING POPULATION SURVEY FOR WISCONSIN, 1973-2003



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TITLE: WATERFOWL BREEDING POPULATION SURVEY FOR WISCONSIN, 1973-2003.

STRATA SURVEYED: Southeast Central (SEC), Northern High Density (NHI), Northern Low Density (NLO) and Southwest Driftless (SWD).

DATES: April 28 - May 22, 2003.

DATA SUPPLIED BY: Wisconsin Department of Natural Resources (WDNR), Great Lakes Indian Fish and Wildlife Commission (GLIFWC), and U.S. Fish and Wildlife Service (USFWS).

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ABSTRACT: The 2003 Waterfowl Breeding Population Survey for Wisconsin was conducted April 28 - May 9, following methods of the North American waterfowl population survey. However, there were 9 transects that were rerun and as a result, the ending date of surveys in the north was May 22. This year was the 31st consecutive year we have conducted the survey. This year marks the third year of operational surveys in our new Southwest Driftless (SWD) stratum. In 2001 we adjusted our historical state estimates for ducks and geese to account for the addition of this stratum (see methods section). Statewide precipitation levels during October 1-February 28 were 32% below normal. From March 1-May 31, 2003 statewide precipitation levels were 19% above normal. The number of non-linear wetlands compared to the long-term mean (30 years) was below

normal in the Southeast Central (SEC), below normal in the Northern High (NHI), above normal in the Northern Low (NLO) and below the long-term average in the SWD (6-year average). The population estimate for total ducks for the revised surveyed area was 60% higher than the long-term mean and 24% lower than 2002. The 2003 mallard population estimate was 60% higher than the long-term mean and 26% lower than 2002. The blue-winged teal population estimate was 15% below the long-term mean and 26% below the 2002 estimate. The local Canada goose population estimate increased 64% compared to 2002 and was 349% above the previous 17-year mean. It was the highest goose population estimate recorded for Wisconsin.

METHODS: The breeding waterfowl survey in Wisconsin is a stratified double sampling scheme patterned after the North American waterfowl breeding population survey developed by the USFWS (Anon. 1977), but modified for local conditions (March *et al.* 1973). Fifty-five transects, each 30 miles long and 1/4 mile wide, were randomly selected in 1973 within 3 strata of Wisconsin: SEC; NHI; and NLO, based on duck densities and habitat (Figure 2). These strata total 43,359 square miles. In 1997, we added eleven survey transects of comparable size within the unglaciated SWD stratum (12,311 square miles) and included this strata in our statewide population estimates. This area was not surveyed prior to 1997 because of its low wetland density.

The 2002 survey was conducted from April 28 - May 10, with 9 routes redone and finished on May 22. A Cessna 182 aircraft was used, flying 80-85 mph at a maximum altitude of 200 feet. An observer recorded waterfowl data from each side of the plane, with the observer on the north side of the plane recording number and type of wetland basins within the transect. We continued to divide the state into north and south crew areas. Two aerial crews were used. The aerial portion of the survey was done in 6 days in the south (4/28-5/8) and 5 days in the north (5/2-5/21). The ground truthing was done on 10 days that spanned 4/29-5/22. The ground counts were mostly done 0-2 days after the aerial survey, except for 3 transects completed 3, 4, and 5 days after the air survey.

The determination of wetland type from the air is difficult to standardize when observers change over the years. Pooling data into linear (streams and ditches) and nonlinear (types I-VIII) wetland groups resolves some of the typing problems. The same aerial observers are used for 5-year periods to minimize problems with observer bias. None of the 4 aerial observers was new for the 2003 survey.

Aerial visibility correction factors (R) for ducks not seen by the aerial crew were determined by ground truthing segments (10-15 miles) of 26 (including 4 in the SWD stratum) transects within 3 days of the air count. The number of ground truthing segments has varied from 22-32 over the years of the survey. R was calculated separately for each stratum-species group, but when the coefficient of variation (CV) of R exceeded

20%, the estimate of R was considered unreliable and the data for R were pooled for all strata (Bartelt and Gatti 1987). When the CV of R still exceeded 20% for the pooled strata, data from the prior year were iteratively added until the CV of R was below 20%, in accordance with USFWS recommendations (Smith 1995). Beginning in the 1993 report, we calculated all population estimates using these procedures for use of R. We also calculated mallard population estimates for all years (1973-01) using these procedures to standardize past and present data. Consequently, the mallard population estimates for past years listed in this report differ with those printed in the reports prior to 1993. Beginning in the 2001 report, we included the SWD in the calculation of R; this gives us a pooled statewide estimate of R from the 4 regions that were used for the statewide population estimates.

In 2001 we revised all of the annual estimates by including an estimate for that year for the SWD stratum for the years 1973-96. Using the 1997-01 statewide population estimates (SWD included), we calculated the percent the SWD contributed to the statewide total for that 5-year period and then increased the historic estimates to reflect the estimated SWD contribution. During the 1997-01 period, the SWD stratum accounted for 10.1% of the total statewide mallard population estimate, 5.6% of the blue-wing teal population estimate, 7.1% of the total other duck population estimate, and 8.2% of the total Canada goose population estimate. Thus, the historical estimates for the period 1973-96 were adjusted by the reciprocal of those individual percentages to generate statewide population estimates for those years. For years 1997-01, we added the yearly estimates reported for the SWD to the historical population estimates. This method allows us to now generate estimates for the entire state, as basically all of the state is now included in one of the 4 strata. We are considering making a similar adjustment next year to incorporate two additional years of data.

Survey results separate mallards and blue-winged teal from other ducks. Wood ducks are included with "other ducks" because they are not adequately inventoried using aerial surveys (Bowers and Martin 1975). Population estimates for blue-winged teal in northern Wisconsin, and "other ducks", and Canada geese in all strata should be treated with caution due to low sample sizes.

The survey was designed to detect a 20% change in total ducks observed. The population estimates of individual species groups have wider confidence intervals because of lower sample sizes and added variability of R. Population estimates are best used as trend indicators. Prior to 1996, when groups (5 or more) of ducks made up a large portion of the ducks seen, they were not counted in the population estimates. These groups were believed to be migrants heading outside the state and their inclusion would add variance to our resident population estimates. These ducks (except scaup) were included in the population estimates beginning in 1996 to make our

methods consistent with those of the federal survey. Lesser scaup are not included in the state duck population estimates because they rarely breed in Wisconsin.

The survey timing was near average in 2003, but it appears it was flown early relative to spring phenology, as many ducks were observed in groups in all 3 of the primary survey regions. While only 10% of the mallards and blue-winged teal were observed in groups, 43% of the other ducks and 26% of Canada geese were in groups. It is likely that many of the birds in flocks were in the process of migration, and did not represent local breeding birds. Thus, the 2003 estimates for other ducks and Canada geese are likely high, due to the inclusion of a migratory component.

RESULTS AND DISCUSSION:

Precipitation: We present regional (Division) precipitation data provided by the State Climatology Office. Negative deviations from normal were experienced statewide from October 1, 2002 to February 28, 2003 with SE Wisconsin (Division 9) showing the largest negative deviation from normal (5.14 inches). Precipitation statewide during this period was well below normal (-32%) (Table 1).

Precipitation statewide during the spring period of March 1 - May 31, 2003 was 19% above normal. NW Wisconsin (Division 1) experienced the greatest positive deviation from normal (3.16 inches).

Wetlands: Wetland numbers were generally down in 2003 (Table 2). Total non-linear basins were: down 39% in the SEC and 30% below the long-term (30 year) mean; down 27% in the NHI and 5% below the long-term (30 year) mean; down 30% in the NLO but 5% above the long-term (30 year) mean, and down 47% in the SWD and 43% below its long-term (6 year) mean. Total linear basins were: down 18% from 2002 in the SEC and 21% below the long-term mean; up 3% from 2002 in the NHI and 2% below the long-term mean; up 3% from 2002 in the NLO, but 7% below the long-term mean; and up 2% from 2002 in the SWD, but 17% below the long-term mean (6 years). Total non-linear basins provide a more reliable indicator of changes in wetland numbers between years by reducing observer bias when determining wetland type from the air.

Mallards: The 2003 total mallard population estimate was 276,403. The total population estimate decreased 26% from 2002 ($Z=1.70$, $p=0.09$), but was 60% above the long-term mean (Tables 3, 4, and 5, Figure 4). Last year was the second highest mallard population in the history of the survey. In the SEC, the mallard population estimate decreased 18% from 2002. The mallard population estimates decreased 38%, 36% and 20% in the NHI, NLO and SWD, respectively compared to 2002. The mallard population estimate was 91% above the long-term

mean in the SEC, 12% above the long-term mean in the NHI, 40% above the long-term mean in the NLO and 75% above the calculated long-term mean in the SWD.

Blue-winged Teal: The total blue-winged teal population estimate of 102,329 was 26% below the 2002 estimate ($Z=0.63$, $p=0.53$), and was 15% below the long-term mean (Tables 3, 4, and 5, Figure 5). Blue-winged teal population estimates decreased 30% in the SEC, 83% in the NHI, decreased less than 1% in the NLO and increased 95% in the SWD compared to 2002. Population estimates were 46% below the long-term mean in the SEC, 70% below in the NHI, 116% above in the NLO and 158% above in the SWD.

Other Ducks: The 2002 population estimate for other ducks was 317,857 which represented a 21% decrease from 2002 ($Z=1.03$, $p=0.30$), but is 128% above the long-term mean (Tables 3, 4, and 5). "Other duck" population estimates increased 51% in the SEC, decreased 76% in the NHI, decreased 41% in the NLO, and decreased 68% in the SWD compared to 2002. Population estimates were 357% above the long-term mean in the SEC, 17% below in the NHI, 16% above in the NLO and 15% above the long-term calculated mean in the SWD.

Total Ducks: The total state breeding duck population estimate (697,589) decreased 24% from 2002 ($Z=1.88$, $p=0.06$), but was 60% above the long-term mean (Tables 3 and 5 and Figure 6). Last year's estimate (913,491) represented the highest estimate since we began the survey. Total duck population estimates increased 6% in the SEC, decreased 67% in the NHI, decreased 31% in the NLO and 28% in the SWD from 2002. Total duck population estimates were above the long-term mean in the SEC (101%), down 17% in the NHI, up 45% in the NLO and 67% above the calculated long-term mean in the SWD.

Canada Geese: This survey was not originally designed for surveying Wisconsin's resident Canada goose population. Canada goose counts and population estimates were not included in this report prior to 1986 because of the small sample size. However, aerial counts of geese have increased steadily since the mid-1980s, making population estimates useful indices to population trends of breeding Canada geese. Reports by WDNR field personnel also indicate an increasing breeding Canada goose population in Wisconsin over this time period.

The 2003 Canada goose population estimate increased 68% in the SEC, increased 68% in the NHI, increased 28% in the NLO and increased 73% in the SWD compared to 2002 population estimates. The total Canada goose population estimate of 235,448 increased 64% from 2002 ($Z=1.81$, $p=0.07$) and was 349% above the long-term mean (Tables 3, 4 and 5; Fig. 7). This estimate includes groups.

General Comments: We are pleased that we have added the SWD portion of the state to our survey, thus making the survey truly a statewide survey. We presented estimates for the SWD as discussed in the Methods and Results sections for the period 1973-96 so that the yearly data would be comparable.

Although we consider the timing of this year's survey average, the elevated numbers of blue-winged teal and other ducks observed in groups suggests that the timing may have been early in relation to spring phenology. Population estimates for other ducks and Canada geese have been appreciably influenced by the inclusion of migratory flocks. The relatively low proportions of mallards and blue-winged teal found in flocks in the primary survey regions suggest, however, that the population estimates for these species were little influenced by the presence of migrants.

We continue to believe the Canada goose estimate is low. This is due to the fact that the survey was not stratified based on Canada goose densities and that the survey is flown during a period when a substantial number of goose nests are within a couple days of hatching, are in the process of hatching, or have hatched. 2003 likely represented a year of average nesting phenology for Wisconsin giant Canada geese. Production of local geese will likely be excellent in 2003.

Entering the breeding season, wetland conditions were below average across most of the state. Heavy rains during late May and early June, improved conditions somewhat. However, conditions began to deteriorate in mid June, especially in the SEC and SWD due to low rainfall.

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Table 1. Wisconsin average precipitation from October 1, 2002- February 28, 2003, and March 1-May 31, 2003.

Oct. 1, 2002-February 28, 2003				March 1, 2003- May 31, 2003		
Division	Total (inches)	Departure from Normal* (inches)	Percent Change from Normal*	Total (inches)	Departure from Normal* (inches)	Percent Change from Normal*
1 (NW)	5.98	-1.79	-23.0	10.62	+3.16	+42.4
2 (NC)	6.98	-1.51	-17.8	10.33	+2.84	+37.9
3 (NE)	7.35	-1.26	-14.6	9.48	+1.56	+20.0
4 (WC)	5.65	-1.97	-25.9	10.47	+1.8	+20.8
5 (C)	5.95	-2.17	-26.7	9.36	+0.75	+8.7
6 (EC)	5.77	-3.22	-35.8	8.75	+0.9	+11.5
7 (SW)	4.31	-3.81	-46.9	9.76	+0.52	+5.6
8 (SC)	5.09	-3.94	-43.6	10.53	+1.46	+16.1
9 (SE)	4.71	-5.14	-52.2	10.16	+1.36	+15.5
Statewide Average	5.75	-2.76	-32	9.94	+1.59	+19

* normal is defined as the average for the years 1971-2000.

Table 2. Numbers of wetlands per square mile observed, 1973-2003.

Stratum and Wetland Type*	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
SEC												
I,II,VI	5.8	3.0	3.4	3.7	1.0	2.8	5.6	1.7	4.5	1.8	3.3	7.8
III	1.2	0.8	1.1	1.3	0.7	0.6	0.9	0.8	1.1	1.1	0.8	0.6
IV,V	1.6	2.0	1.8	1.6	1.4	2.1	2.5	2.4	2.7	2.6	2.0	2.0
VII,VIII	0.8	0.5	0.8	1.1	0.3	0.8	2.0	0.9	1.3	1.5	0.8	1.4
Tot.Nonlin.	9.5	6.4	7.1	7.7	3.3	6.3	11.1	5.8	9.7	7.0	6.9	11.8
Stream	1.4	1.2	1.3	1.5	0.9	1.5	1.7	1.4	1.7	1.7	2.0	2.2
Ditch	1.0	1.5	1.9	1.7	1.4	2.2	2.5	2.2	2.9	2.5	2.8	4.1
Tot.Linear	2.4	2.7	3.1	3.2	2.3	3.7	4.2	3.6	4.6	4.2	4.8	6.3
NHI												
I,II,VI	1.1	1.3	2.6	2.4	0.9	3.6	4.3	1.4	4.9	3.4	4.2	5.5
III	0.7	0.8	0.9	0.7	0.8	0.6	0.6	0.8	0.7	1.8	0.7	1.0
IV,V	2.8	2.9	3.1	3.0	2.5	2.8	3.4	3.3	3.1	4.6	3.5	3.9
VII,VIII	0.7	0.5	0.7	0.8	0.3	2.1	4.6	1.3	3.2	2.0	1.3	3.4
Tot.Nonlin.	5.3	5.5	7.3	7.0	4.5	9.1	13.0	6.7	11.8	11.8	9.7	13.9
Stream	1.9	1.4	1.3	1.5	1.1	2.1	2.5	1.7	2.4	2.4	2.2	3.2
Ditch	0.1	0.1	0.2	0.2	0.1	0.4	0.3	0.2	0.4	0.5	0.5	0.8
Tot.Linear	2.0	1.5	1.5	1.6	1.2	2.5	2.8	1.9	2.7	2.9	2.7	3.9
NLO												
I,II,VI	2.1	1.0	1.0	1.6	0.5	2.1	3.5	0.9	3.9	1.8	2.3	5.7
III	0.7	0.5	0.6	0.4	0.4	0.5	0.4	0.6	0.5	1.0	0.3	0.5
IV,V	1.7	0.9	1.1	1.1	1.1	1.5	1.8	2.1	1.5	2.3	1.7	1.6
VII,VIII	1.0	0.5	0.7	0.8	0.1	2.0	4.6	1.1	3.0	3.7	1.5	2.8
Tot.Nonlin.	5.5	2.9	3.4	3.8	2.2	6.1	10.2	4.6	9.0	8.7	5.8	10.6
Stream	3.1	2.1	2.1	2.3	1.6	3.3	3.6	3.1	3.6	3.6	3.7	4.4
Ditch	0.3	0.4	0.4	0.4	0.2	0.6	0.6	0.4	0.5	0.5	0.6	1.1
Tot.Linear	3.3	2.5	2.5	2.7	1.8	3.9	4.2	3.5	4.2	4.1	4.3	5.5

* Wetland classification system from March et al. 1973.

Table 2 Continued.

Stratum and Wetland Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
SEC												
I,II,VI	3.5	3.7	4.3	2.4	3.8	2.7	6.1	6.9	10.5	4.6	4.4	4.9
III	0.9	0.6	1.2	0.8	1.2	1.1	1.1	1.2	1.5	1.9	1.3	1.0
IV,V	2.4	2.5	3.0	2.9	2.8	3.2	3.2	2.5	3.5	3.0	3.5	3.5
VII,VIII	1.1	1.1	0.7	0.9	1.4	1.1	2.2	1.3	2.0	1.1	0.8	1.5
Tot.Nonlin.	7.8	7.9	9.1	7.1	9.2	8.1	12.7	11.9	17.5	10.5	10.0	10.9
Stream	2.0	1.5	2.2	2.2	1.8	1.7	2.1	2.1	1.9	2.0	2.1	1.8
Ditch	3.9	2.6	2.7	2.4	3.3	2.3	3.5	2.8	3.2	2.8	2.7	2.5
Tot.Linear	5.9	4.0	4.9	4.7	5.1	4.0	5.6	4.9	5.1	4.8	4.8	4.3
NHI												
I,II,VI	3.2	9.1	3.4	2.9	4.0	3.4	8.2	6.8	5.7	2.9	3.3	2.8
III	1.1	0.4	1.4	1.2	2.2	1.3	1.8	0.7	1.3	2.5	2.8	1.2
IV,V	3.9	3.8	3.1	5.1	5.1	4.2	5.0	3.2	4.4	4.5	5.1	6.0
VII,VIII	1.6	2.9	1.6	2.1	4.3	3.4	5.8	1.8	1.7	1.1	2.1	3.6
Tot.Nonlin.	9.8	16.2	9.5	11.3	15.6	12.3	20.8	12.4	13.1	10.9	13.2	13.5
Stream	2.4	2.0	2.0	2.0	2.5	2.7	3.1	2.3	2.4	2.5	2.3	2.5
Ditch	0.4	0.6	0.5	0.4	0.8	0.5	1.0	0.4	0.3	0.4	0.6	0.4
Tot.Linear	2.8	2.6	2.5	2.4	3.3	3.3	4.1	2.7	2.7	2.9	2.8	3.0
NLO												
I,II,VI	2.8	6.1	4.0	3.8	6.5	4.0	9.7	4.1	10.6	3.8	5.0	3.0
III	0.4	0.3	0.7	0.5	1.1	0.6	0.9	0.7	0.9	1.6	1.5	0.2
IV,V	2.1	2.0	2.0	2.8	3.0	2.7	3.0	1.9	2.8	2.5	3.1	2.3
VII,VIII	1.3	2.3	1.1	2.6	2.8	3.0	5.9	1.6	2.5	1.3	1.4	2.5
Tot.Nonlin.	6.5	10.7	7.8	9.6	13.5	10.3	19.6	8.3	16.8	9.3	11.0	8.0
Stream	3.4	3.0	2.9	2.9	3.4	4.1	3.9	3.6	3.2	3.6	3.8	3.2
Ditch	0.8	0.6	0.5	0.7	1.0	0.9	1.7	0.8	0.9	1.0	1.0	0.8
Tot.Linear	4.2	3.6	3.3	3.6	4.4	5.0	5.5	4.4	4.1	4.6	4.7	4.0

Table 2. Continued

Stratum and Wetland Type	1997	1998	1999	2000	2001	2002	2003	1973-02 mean	% change from 2002	% Change from 1973-02 mean
SEC										
I,II, VI	6.6	3.5	3.5	1.6	3.2	4.9	1.9	4.2	-61.5	-55.3
III	1.5	0.8	0.8	0.1	1.0	0.6	0.3	1.0	-46.0	-69.3
IV, V	3.9	3.1	3.6	3.5	3.4	3.9	3.5	2.8	-9.3	27.7
VII, VIII	0.9	0.9	0.8	0.6	0.8	1.0	0.6	1.1	-35.5	-41.6
Tot. Nonlin.	12.9	8.4	8.6	5.8	8.4	10.4	6.4	9.1	-38.6	-30.1
Stream	1.9	1.8	1.8	1.6	1.7	1.7	1.6	1.7	-8.1	-10.0
Ditch	3.1	2.5	1.3	1.5	2.0	2.4	1.8	2.5	-24.9	-27.9
Tot. Linear	5.0	4.2	3.0	3.1	3.7	4.1	3.4	4.2	-17.9	-20.5
NHI										
I,II, VI	3.7	2.4	4.2	2.4	6.2	4.4	2.4	3.9	-46.3	-39.5
III	2.6	1.3	1.7	1.5	2.8	2.0	1.2	1.3	-39.8	-10.3
IV, V	3.7	3.6	4.0	4.5	3.7	4.9	5.0	3.9	3.0	26.8
VII, VIII	2.2	2.6	2.0	2.6	4.1	3.9	2.5	2.4	-36.8	1.9
Tot. Nonlin.	12.2	9.9	11.9	11.0	16.8	15.1	11.0	11.6	-27.2	-5.0
Stream	2.2	2.0	2.3	2.4	2.5	2.1	2.2	2.2	4.3	1.3
Ditch	0.4	0.2	0.6	0.3	0.5	0.4	0.3	0.4	-5.7	-16.9
Tot. Linear	2.6	2.2	2.8	2.6	2.9	2.5	2.6	2.6	2.9	-1.5

Table 2. Continued

Stratum and Wetland Type	1997	1998	1999	2000	2001	2002	2003	1973-02 mean	% change from 2002	% Change from 1973-02 mean ¹
NLO										
I,II, VI	10.6	2.9	5.2	4.4	6.9	6.2	3.8	4.3	-39.1	-12.8
III	1.6	0.7	1.3	1.3	1.3	1.5	0.8	0.8	-44.5	3.7
IV, V	3.1	2.1	2.2	2.1	2.1	3.0	2.6	2.1	-12.6	24.1
VII, VIII	3.3	1.5	1.7	2.8	3.2	3.7	2.8	2.3	-24.4	23.0
Tot. Nonlin.	18.6	7.1	10.5	10.7	13.5	14.4	10.0	9.5	-30.4	5.4
Stream	3.5	3.6	3.9	3.5	3.4	2.9	3.0	3.3	2.5	-10.2
Ditch	1.4	0.6	0.5	0.6	0.6	0.7	0.7	0.7	4.3	6.1
Tot. Linear	4.9	4.3	4.4	4.1	4.0	3.6	3.7	4.0	2.8	-7.3
SWD										
I,II, VI	2.3	0.7	2.0	1.2	1.2	1.7	0.6	1.7	-62.0	-62.5
III	0.5	0.4	0.4	0.2	0.2	0.2	0.3	0.4	53.3	-25.8
IV, V	2.0	1.2	1.8	1.4	1.4	2.0	1.2	1.6	-39.5	-25.3
VII, VIII	0.4	0.0	0.1	0.1	0.1	0.3	0.1	0.2	-70.4	-50.5
Tot. Nonlin.	5.1	2.3	4.2	2.9	2.9	4.2	2.2	3.9	-46.8	-42.6
Stream	3.7	2.9	4.0	3.4	3.4	2.7	2.7	3.2	1.4	-14.3
Ditch	0.8	0.3	0.7	0.4	0.4	0.3	0.4	0.6	10.7	-33.1
Tot. Linear	4.5	3.2	4.7	3.8	3.8	3.0	3.1	3.7	2.4	-17.2

¹ Years used to determine SWD mean are 1997-2002.

Table 3. Breeding waterfowl population estimates in Wisconsin, 1973-2003.¹

Stratum and Year	Mallard	Blue-Winged Teal	Other Ducks	Total	Canada Geese 2
Southwest					
1973	11600	11100	3400	29900	
1974	9700	9800	4400	27600	
1975	11000	14100	5000	35900	
1976	10500	9300	3800	26700	
1977	9200	8000	2900	22800	
1978	6400	6000	4600	19500	
1979	8300	7700	7400	27000	
1980	13300	4900	4900	23700	
1981	14100	13200	9600	42400	
1982	8800	6300	2500	19300	
1983	14500	3700	4700	22600	
1984	9200	3200	7600	21100	
1985	7700	3900	7800	21100	
1986	11400	5000	6700	24600	600
1987	11500	8900	6300	29900	700
1988	16000	5900	3500	25700	700
1989	22200	8000	7800	38800	1800
1990	15400	6500	10000	33600	1500
1991	18400	3700	14600	37200	1600
1992	28800	8300	14500	52300	2500
1993	19200	5100	6700	30900	2900
1994	31100	7800	9000	46900	3300
1995	24400	6700	18500	51100	3800
1996	32800	4200	24000	60500	6300
1997	23400	9700	8100	41200	4300
1998	9800	0	11200	21000	4100
1999	20600	8300	24700	53500	8800
2000	47700	3000	12800	63500	10600
2001	19400	3400	21900	44700	7700
2002	38500	9059	35913	83472	12289
2003	30659	17637	11670	59966	21256
Sum 1973-2002	524900	204759	304813	1078472	73489
Average 1973-02	17497	6825	10160	35949	4323

Table 3. Continued

Stratum and Year	Mallard	Blue-Winged Teal	Other Ducks	Total	Canada Geese 2
Southeast Central					
1973	63900	101600	24900	190400	
1974	62800	143200	46400	252400	
1975	62000	213100	41000	316100	
1976	55700	115500	9500	180700	
1977	41800	56700	12500	111000	
1978	32000	62300	22900	117200	
1979	37000	96500	13300	146800	
1980	50600	51600	32400	134600	
1981	64500	149200	54200	267900	
1982	44400	84700	14500	143600	
1983	61800	52000	12100	125900	
1984	37600	19300	18400	75300	
1985	40400	22000	4100	66500	
1986	55200	63500	7400	126100	3500
1987	59000	92700	22500	174200	5100
1988	56600	46700	10900	114200	5000
1989	75700	76000	37000	188700	8900
1990	58100	59100	31500	148700	9800
1991	74400	36800	64300	175500	13700
1992	131800	100200	98800	330800	22700
1993	98800	59800	36900	195500	22400
1994	187600	103700	51100	342400	30400
1995	137800	9500	93500	326300	32800
1996	152100	61300	179500	392900	54200
1997	99500	50900	64300	214800	56000
1998	99400	42500	82000	223900	51500
1999	107600	67200	53500	228400	47300
2000	201700	65100	135400	402200	72900
2001	7522	68107	66398	209727	45420
2002	190867	57610	150197	398674	95995
2003	155797	40235	227051	423083	160874
Sum 1973-2002	2448189	2228417	1491395	6321401	577615
Average 1973-02	81606	74281	49713	210713	33977

Table 3. Continued

Stratum and Year	Mallard	Blue-Winged Teal	Other Ducks	Total	Canada Geese 2
Northern High					
1973	13500	19300	1500	34300	
1974	12900	9700	8700	31300	
1975	23200	18100	20000	61300	
1976	24300	29600	12700	66600	
1977	19100	48600	25400	93100	
1978	14100	20300	30700	65100	
1979	22100	21800	8200	52100	
1980	42600	17000	20300	79900	
1981	34200	50600	16300	101100	
1982	19700	13100	14500	47300	
1983	28500	6900	15200	50600	
1984	19800	27900	58000	105700	
1985	16000	21700	71900	109600	
1986	24500	12900	28500	65900	2900
1987	25100	22700	35400	83200	3000
1988	49900	29900	23200	103000	2500
1989	55800	24800	38400	119000	7700
1990	43100	25400	67800	136300	5300
1991	43000	9500	70900	123400	4100
1992	57400	14400	45500	117300	4800
1993	35300	9200	18700	63200	8100
1994	50500	12400	24900	87800	3400
1995	43600	5000	67200	115800	8000
1996	50000	1400	42900	94300	11100
1997	30500	6300	41800	78700	15300
1998	34000	15700	54400	104100	9500
1999	59400	7700	49900	117000	19000
2000	77800	22700	74300	174800	22400
2001	37427	21722	92692	151841	13069
2002	65150	33469	139676	238295	20578
2003	40188	5716	33696	79600	34642
Sum 1973-2002	1072477	579791	1219568	2871936	160747
Average 1973-02	35749	19326	40652	95731	9456

Table 3. Continued

Stratum and Year	Mallard	Blue-Winged Teal	Other Ducks	Total	Canada Geese 2
Northern Low					
1973	25600	65600	18700	109900	
1974	10500	12000	3000	25500	
1975	12800	7200	4100	24100	
1976	13400	11100	27400	51900	
1977	21400	28900	300	50600	
1978	11100	18300	6900	36300	
1979	15300	12200	75400	102900	
1980	25400	13800	11400	50600	
1981	27100	23300	54800	105200	
1982	13800	7700	4100	25600	
1983	39000	2900	34100	76000	
1984	24400	7000	23400	54800	
1985	12500	21900	26200	60600	
1986	22200	8600	52400	83200	500
1987	18700	34200	24300	77200	0
1988	36100	23200	11700	71000	400
1989	65800	34600	26800	127200	3200
1990	35300	24500	31600	91400	1300
1991	45900	15200	55900	117000	500
1992	66900	24500	46000	137400	0
1993	37100	17800	32400	87300	1800
1994	38500	15100	41300	94900	2600
1995	36100	13100	80900	130100	1700
1996	90000	8500	91600	190100	5700
1997	42800	2100	42900	87900	7200
1998	32400	6700	60400	99500	11600
1999	54600	5200	29300	89100	12700
2000	88000	12600	92200	192800	7400
2001	30284	20242	85932	136458	9769
2002	77830	38800	76419	193049	14621
2003	49759	38741	45440	133900	18676
Sum 1973-2002	1070814	536842	1171851	2779607	80990
Average 1973-02	35694	17895	39062	92654	4764

Table 3. Continued

Stratum and Year	Mallard	Blue-Winged Teal	Other Ducks	Total	Canada Geese 2
All Stratum					
1973	114500	197600	48500	364400	0
1974	96000	174600	62500	336800	0
1975	109000	252500	70100	437400	0
1976	104000	165500	53400	326000	0
1977	91500	142200	41100	277500	0
1978	63700	106800	65100	238100	0
1979	82600	138200	104300	328700	0
1980	131900	87400	69000	288900	0
1981	139900	236300	134900	516600	0
1982	82600	111800	35600	235800	0
1983	143700	65500	66100	275000	0
1984	91000	57400	107400	256900	0
1985	76600	69500	110000	257800	0
1986	113300	90000	95000	299800	7500
1987	114300	158500	88500	364500	8800
1988	158600	105700	49300	313900	8700
1989	219400	143400	110000	473600	21600
1990	152000	115500	140900	410100	17900
1991	181800	65300	205700	453300	19900
1992	284900	147400	204800	637800	30000
1993	190400	91900	94700	376900	35300
1994	307700	138900	126200	571900	39700
1995	241900	119800	260100	623300	46200
1996	324900	75400	338000	737800	77300
1997	196300	69100	157200	422500	81500
1998	175700	64900	207900	448500	76600
1999	242200	88400	157400	487900	87800
2000	415200	103400	314700	833300	113200
2001	162300	113500	266900	542700	76000
2002	372347	138938	402205	913491	143484
2003	276403	102329	317857	697589	235448
Sum 1973-2002	5180247	3635338	4187505	13051191	891484
Average 1973-02	172675	121178	139584	435040	52440

1 All estimates are rounded to the nearest one hundred.

2 Prior to 1986, Canada goose numbers were too insignificant to include in the survey.

Table 4. Wisconsin breeding waterfowl data.

Species	Area of stratum (mi ²)	Bird density seen from the air (birds/mi ²)	Aerial visibility correction factor ¹	Population estimate	Standard error of the population estimate	<u>Test for differences from 2002</u>	
						Z-statistic	Probability for type 1 error
Mallard							
Stratum ²							
SEC	17,949	3.802	2.283	155,797	27,032.3		
NHI	9,431	1.867	2.283	40,188	12,057.5		
NLO	15,979	1.364	2.283	49,759	15,689.1		
SWD	12,311	1.091	2.283	30,659	7,973.2	1.70	=0.09
Subtotal	55,670			276,403	34,436.2		
Blue-winged teal							
Stratum							
SEC	17,949	0.303	7.387	40,235	15,717.9		
NHI	9,431	0.082	7.387	5,716	3,381.5		
NLO	15,979	0.328	7.387	38,741	26,610.5		
SWD	12,311	0.194	7.387	17,637	9,230.8	0.63	=0.53
Subtotal	55,670			102,329	32,431.7		
Other duck species ³							
Stratum							
SEC	17,949	1.779	7.109	227,051	99,477.9		
NHI	9,431	0.503	7.109	33,696	9,248.1		
NLO	15,979	0.400	7.109	45,440	14,065.3		
SWD	12,311	0.133	7.109	11,670	5,963.2	1.03	=0.30
Subtotal	55,670			317,857	31,960.6		
Canada Geese							
Stratum							
SEC	17,949	2.202	4.070	160,874	38,699.2		
NHI	9,431	0.903	4.070	34,642	15,747.0		
NLO	15,979	0.287	4.070	18,676	6,321.4	1.81	=0.07
SWD	12,311	0.424	4.070	21,256	8,724.9		
Subtotal	55,670			235,448	43,147.2		

¹ Aerial Visibility Correction Factor= number of birds seen from the ground divided by the number seen from the air on air-ground segments; The coefficient of variation (CV) of R was not precise enough (>20%) to use for individual species regions in 2003. When air-ground data was pooled from all regions by species the R was still not precise enough for any species groups. For mallards, blue-winged teal, other ducks and geese 2, 6, 5 and 2 years of air-ground data were added, respectively.

² SEC=Southeast Central, NHI = Northern High, NLO= Northern Low, SWD=Southwest

³ Included are wood duck in all 4 strata, ring-necked duck in the SEC, NHI & NLO, common and hooded merganser in the SEC, NHI & NLO, green-winged teal in the SEC, NHI & NLO, northern shoveler in the SEC and NLO, common goldeneye in the NLO & SWD and red-breasted merganser and ruddy duck in the SEC.

Table 5. Breeding waterfowl population estimates in Wisconsin, 2003 (estimates in thousands)

Species	2003	1973-2002 mean ¹	Percent change from 2002	Percent change from 1973-02 mean
Mallard				
Stratum ²				
SEC	155.8	81.6	-18.3	90.9
NHI	40.2	35.8	-38.3	12.3
NLO	49.8	35.7	-36.0	39.5
SWD	30.7	17.5	-20.3	75.4
Subtotal	276.4	172.7	-25.8	60.0
Blue-winged teal				
Stratum				
SEC	40.2	74.3	-30.2	-45.9
NHI	5.7	19.3	-83.0	-70.5
NLO	38.7	17.9	0.0	116.2
SWD	17.6	6.8	94.6	158.8
Subtotal	102.3	121.2	-26.3	-15.6
Other duck species ³				
Stratum				
SEC	227.1	49.7	51.2	356.9
NHI	33.7	40.7	-75.9	-17.2
NLO	45.4	39.1	-40.6	16.1
SWD	11.7	10.2	-67.5	14.7
Subtotal	317.9	139.6	-21.0	127.7
Total Ducks				
Stratum				
SEC	423.1	210.7	6.1	101.0
NHI	79.6	95.7	-66.6	-16.8
NLO	133.9	92.7	-30.6	44.5
SWD	60.0	36.0	-28.1	66.7
Subtotal	697.6	435.0	-23.7	60.4
Canada Geese				
Stratum				
SEC	160.9	34.0	67.6	373.2
NHI	34.6	9.5	68.0	264.2
NLO	18.7	4.8	28.1	290.0
SWD	21.3	4.3	73.2	395.3
Subtotal	235.5	52.4	64.1	349.4

¹ Mean for Canada geese determined from 1986-02 data.² SEC=Southeast Central, NHI = Northern High, NLO= Northern Low, SWD=Southwest.³ Included are wood duck in all 4 strata, ring-necked duck in the SEC, NHI & NLO, common and hooded merganser in the SEC, NHI & NLO, green-winged teal in the SEC, NHI & NLO, northern shoveler in the SEC and NLO, common goldeneye in the NLO & SWD and red-breasted merganser and ruddy duck in the SEC.

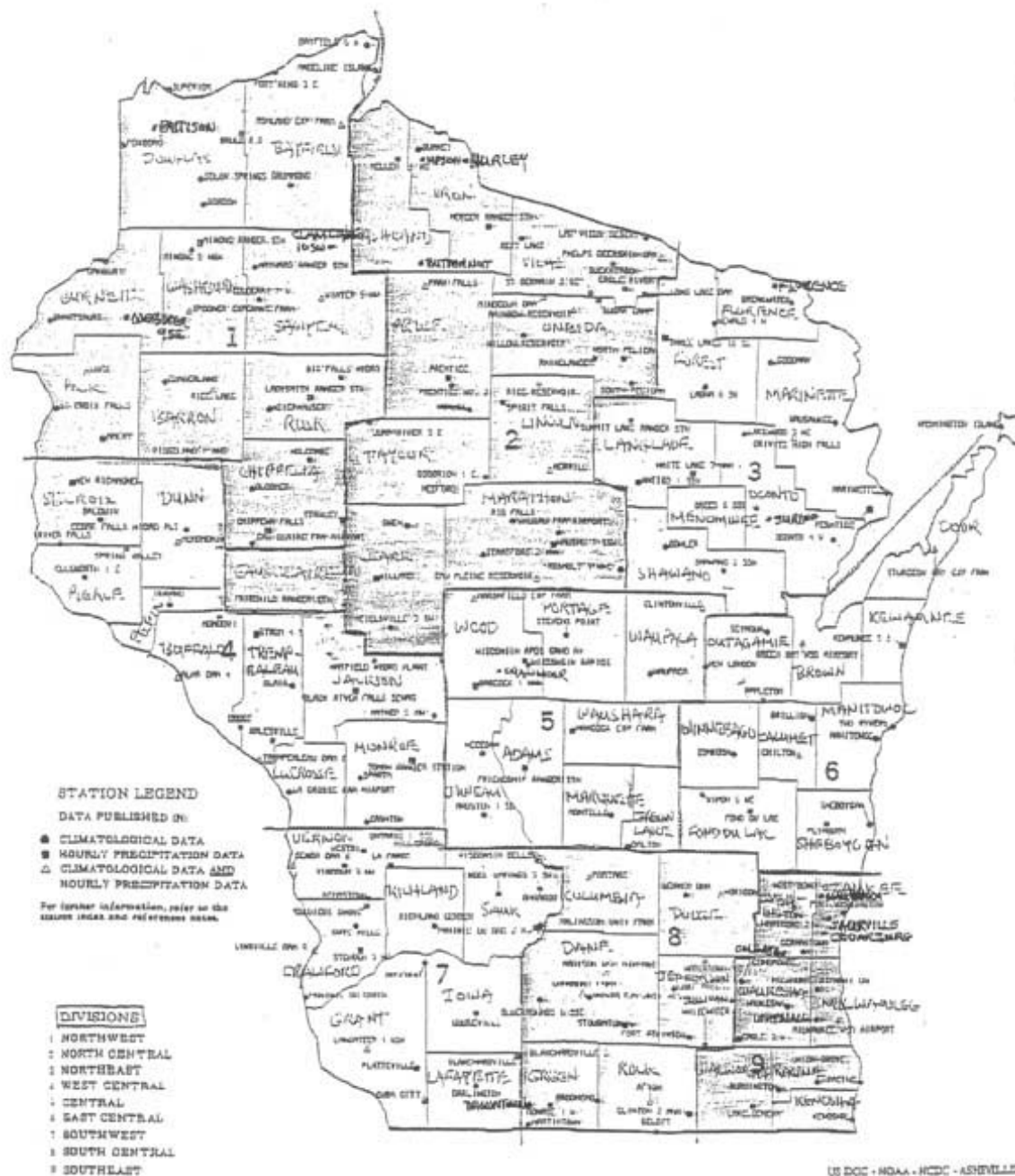


Figure 1. Wisconsin Climatological Divisions



Figure 2. Transect Lines and Regions Surveyed

Figure 3. Survey Flight Information

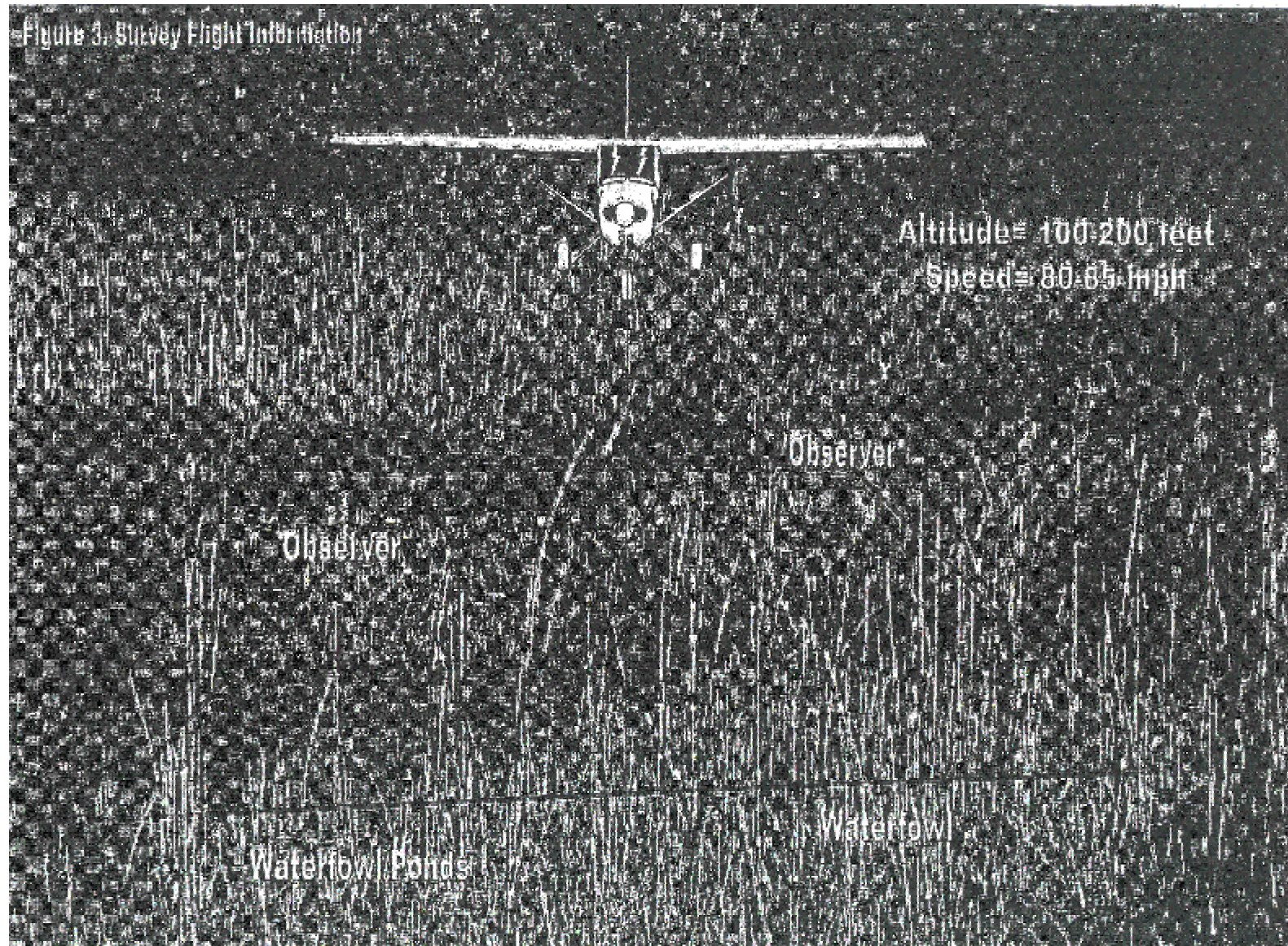


Fig. 4 Wisconsin Mallard breeding population estimates, 1973-2003

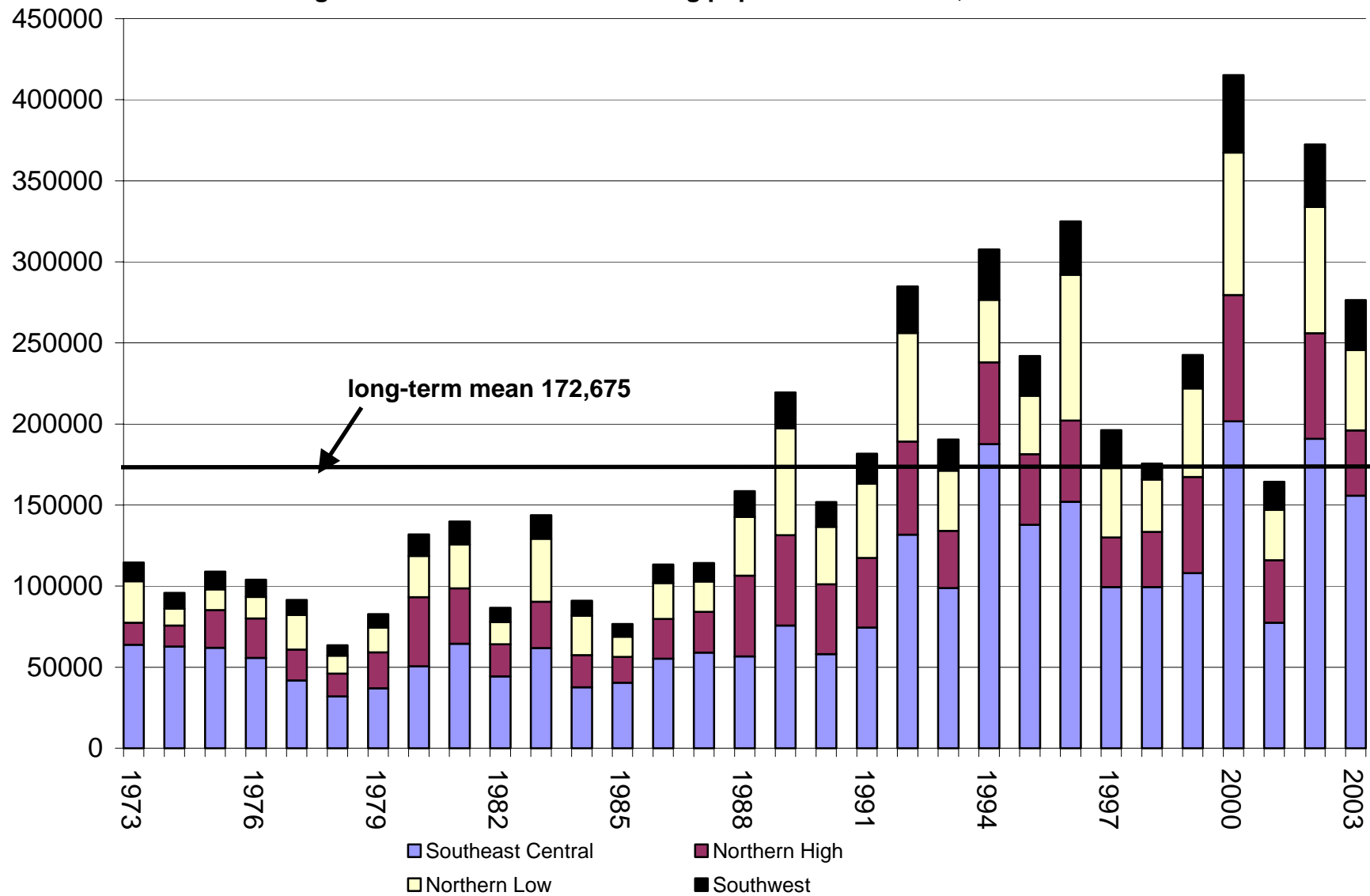


Fig. 5 Wisconsin blue-winged teal breeding population estimates, 1973-2003

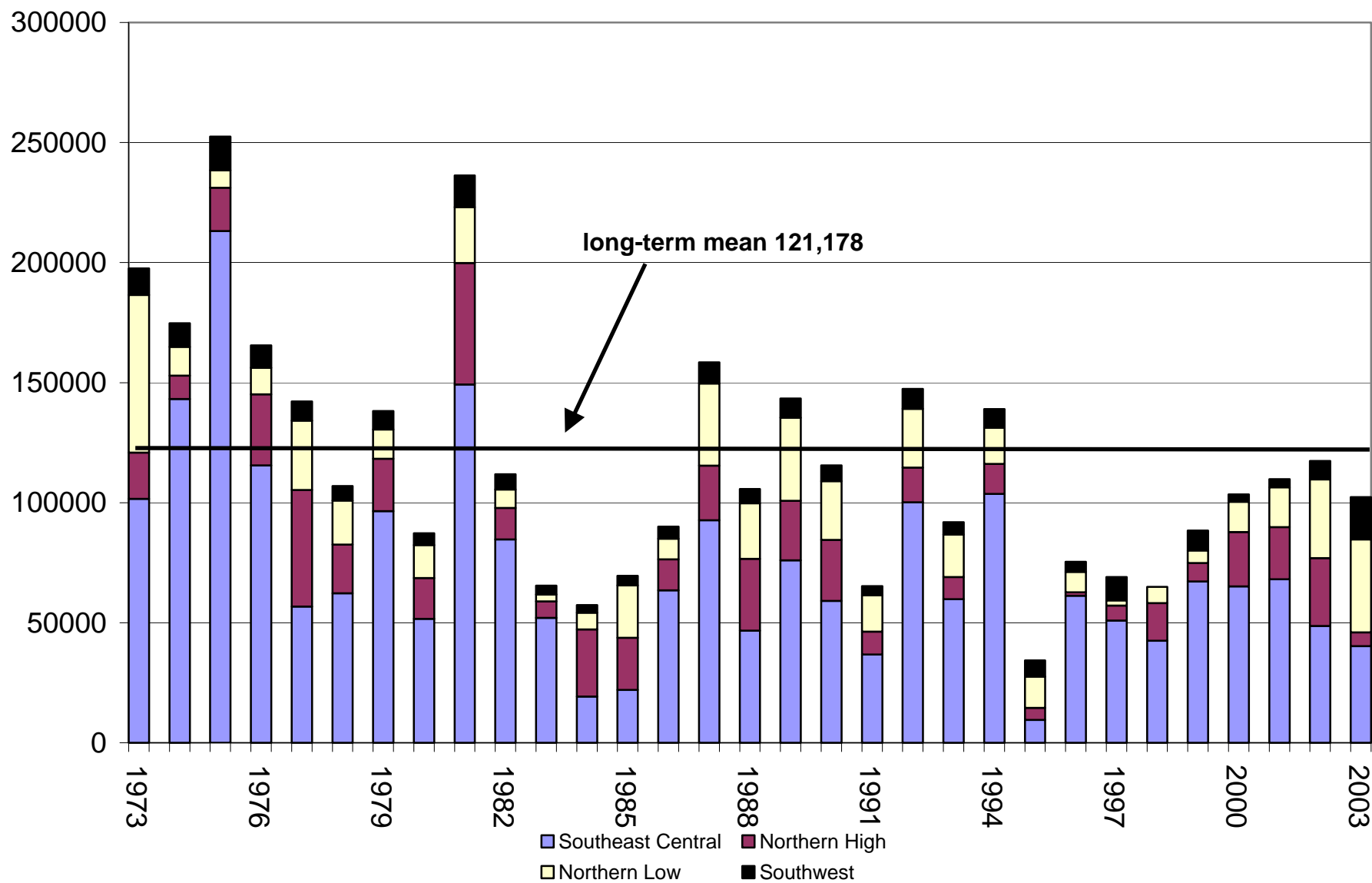


Fig. 6 Wisconsin total breeding duck population estimates, 1973-2003

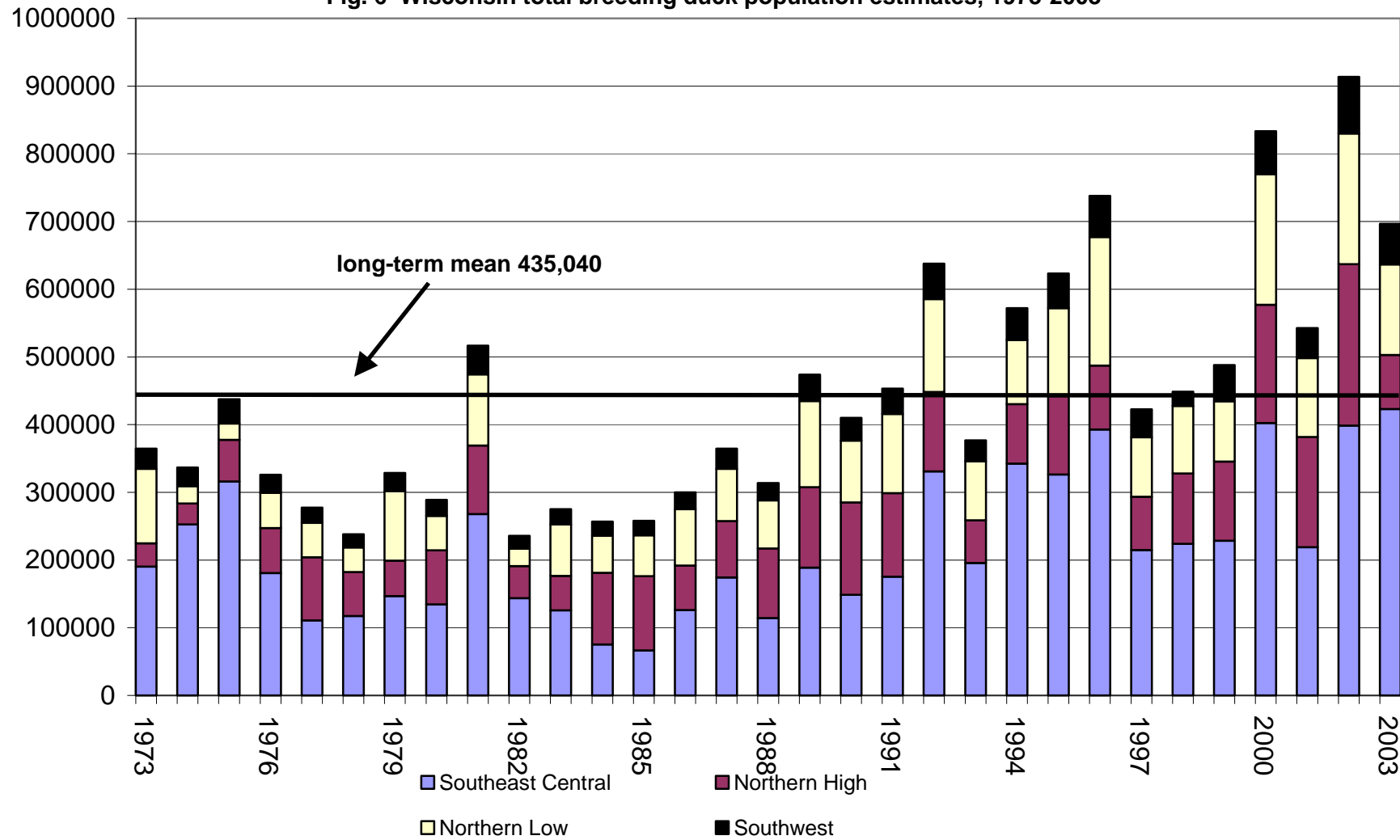
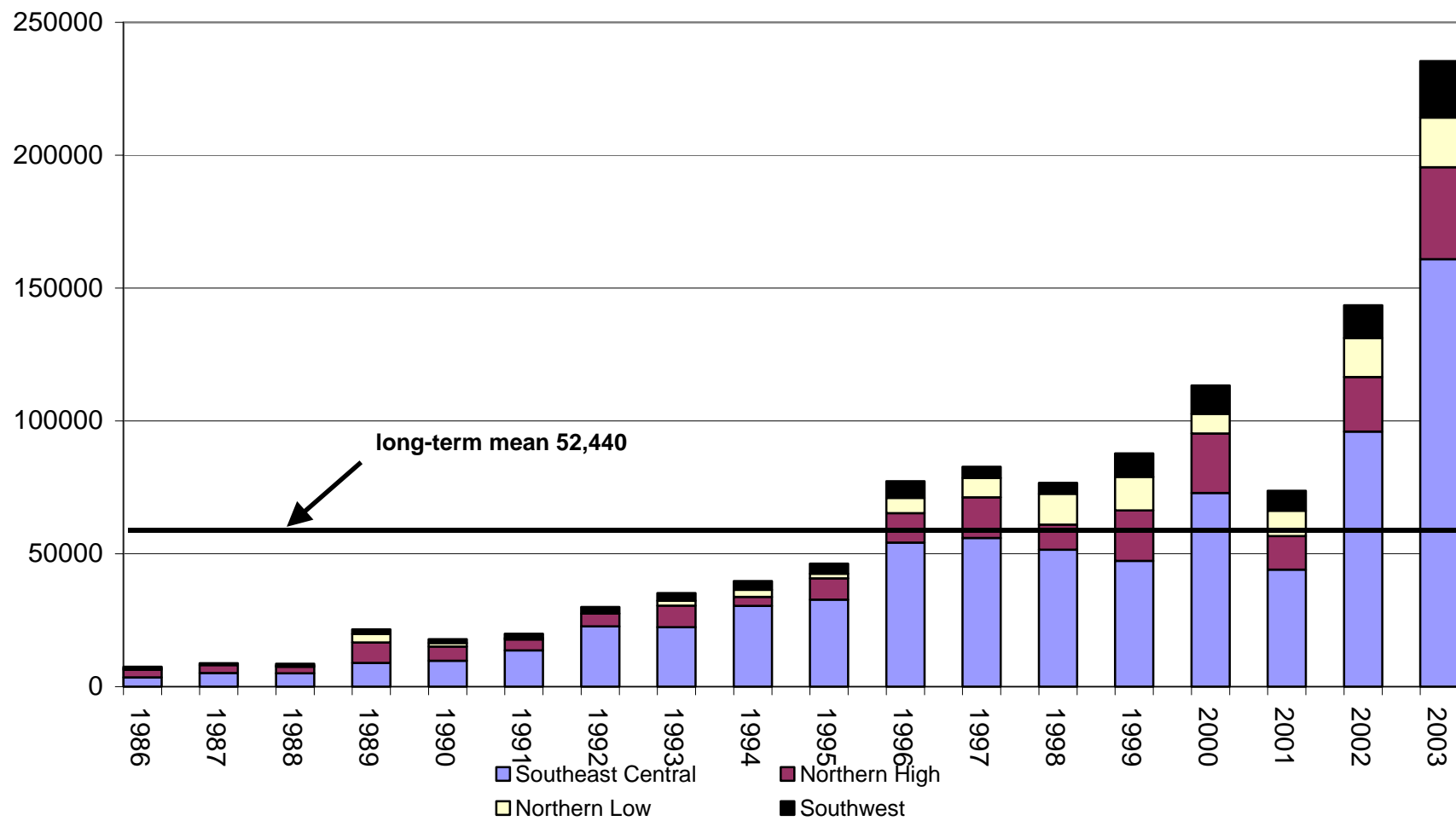


Fig. 7 Wisconsin Canada goose breeding population, 1986-2003.



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